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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/298,297	04/23/1999	DUNCAN W. MCBRANCH	S-91723	1892

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EXAMINER	
MARKHAM, WESLEY D	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 11/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/298,297	MCBRANCH, DUNCAN W.	
	Examiner	Art Unit	
	Wesley D. Markham	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 September 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10-23 and 25-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,10-23,25,26,28 and 30* is/are rejected.

7)☒ Claim(s) *27 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 April 1999* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application on 9/6/2005 after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action (i.e., the final Office action mailed on 5/25/2005) has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/6/2005 has been entered.

Response to Amendment

2. Acknowledgement is made of the amendment filed by the applicant on 9/6/2005, in which independent Claims 1 and 14 were amended, Claims 9 and 24 were canceled, and Claims 27 – 30 were added. **Claims 1 – 8, 10 – 23, and 25 – 30** are currently pending in U.S. Application Serial No. 09/298,297, and an Office action on the merits follows.

Drawings

3. The six (6) sheets of drawings filed by the applicant on 4/23/1999 are acknowledged and approved by the examiner.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. The rejection of Claims 14 – 26 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, set forth in paragraph 8 of the previous Office action, is withdrawn in light of the applicant's amendment to independent Claim 14 to change "the nonlinear optical material layer" to "the transparent spacer layer", thereby clarifying the antecedent basis issue raised by the examiner.

6. Claims 1, 6 – 8, 10 – 14, 19 – 23, 25, 26, 28, and 30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. Regarding independent **Claim 1** (from which **Claims 6 – 8 and 10 – 13** depend) and independent **Claim 14** (from which **Claims 19 – 23, 25, 26, and 30** depend), the claims all require, in part, depositing a plurality of layers onto a glass substrate by self-assembling the layers into a superlattice, wherein the layers include a "donor layer" and an "acceptor layer". This limitation renders the scope of the aforementioned claims vague and indefinite because it is unclear what group / genus of materials is encompassed by the terms "donor layer" and "acceptor layer" in the context of the applicant's claimed invention. For example, does the "donor layer"

have to "donate" anything specific to be considered a "donor layer" in the context of the claimed invention? Does the "acceptor layer" have to "accept" anything specific to be considered an "acceptor layer" in the context of the claimed invention? If so, what is required to be "donated" and "accepted"? If not, every layer of material might be considered to be a "donor layer" and an "acceptor layer", as every material will "donate" something (e.g., ion, electron, atom, molecule, light) under some conditions (e.g., irradiation, etching, cleaning) and every material will "accept" something (e.g., ion, electron, atom, molecule, light) under some conditions (e.g., irradiation, deposition, etc.). The applicant's specification gives several examples of materials that are considered to be "donor layers" and "acceptor layers", such as conjugated polymers (polyelectrolytes), fullerenes, porphyrins, and phthalocyanines (see Claim 2). One specific example provided by the applicant includes MPS-PPV as the donor layer and sulfonated C_{60} as the acceptor layer (see page 9 of the specification). However, the limited number of materials disclosed by the applicant does not reasonably convey to one skilled in the art what the scope of the generic terms "donor layer" and "acceptor layer" is in the context of the claimed invention. Please note that Claims 2 – 5, 15 – 18, and 27 – 29 have not been rejected on this grounds because these claims set forth the materials used for the "donor layer" and the "acceptor layer", thereby rendering the scope of these claims clear.

8. **Claims 6 – 8 and 28** require, in part, inserting at least one transparent spacer layer (TSL) between neighboring donor and acceptor layers. However, independent Claim

1, from which Claims 6 – 8 and 28 depend, requires depositing the donor layer directly onto a substrate consisting of non-conductive glass, depositing a NLO material directly onto the donor layer, and depositing an acceptor layer directly onto the NLO material. It is unclear how a TSL could be inserted between neighboring donor and acceptor layers, as required by Claims 6 – 8 and 28, in the context of Claim 1 which, in effect, requires the donor layer and the acceptor layer to be separated by only an NLO material layer (i.e., not a TSL). Therefore, the sequence of layers required by Claims 6 – 8 and 28 is unclear, thereby rendering the scope of the claims vague and indefinite.

9. **Claims 19 – 21** require, in part, the further step of depositing an NLO layer onto the donor layer and depositing a TSL layer between the NLO layer and the acceptor layer. However, independent Claim 14, from which Claims 19 – 21 depend, requires depositing the donor layer directly onto a substrate consisting of non-conductive glass, depositing the transparent spacer layer directly onto the donor layer, and depositing the acceptor layer onto the TSL. It is unclear how the NLO layer could be deposited onto the donor layer and the TSL layer could be deposited between the NLO layer and the acceptor layer, as required by Claims 19 – 21, in the context of Claim 14, which requires that the TSL be deposited directly on the donor layer. Therefore, the sequence of layers required by Claims 19 – 21 is unclear, thereby rendering the scope of the claims vague and indefinite.

10. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

11. **Claims 1 – 8, 10 – 23, 25, 26, and 30** are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for self-assembling specific donor layers (e.g., MPS-PPV), NLO layers (e.g., PAZO), acceptor layers (e.g., sulfonated C_{60}), and transparent spacer layers (e.g., polyelectrolytes such as PEI, PAH, PDDA, PSS, and PPI dendrimers) into superlattices in order to achieve charge and/or energy transfer in a controlled direction, does not reasonably provide enablement for self-assembling the extremely broad genuses of "donor layers", acceptor layers", "non-linear optical material layers", and "transparent spacer layers" into superlattices in order to achieve charge and energy transfer in a controlled direction. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims. After reviewing the applicant's specification, the examiner notes that the only materials disclosed by the applicant to self-assemble into the claimed superlattice having controlled charge and/or energy transfer are very specific in nature (i.e., an anionic conjugated PPV-based polymer such as MPS-PPV for the donor layer, the polyelectrolyte PAZO for the NLO material layer, sulfonated C_{60} for the acceptor layer, and various polyelectrolytes such as PEI, PAH, PDDA, PSS, and PPI dendrimers for the transparent spacer

layer(s) – see pages 9 – 15 of the specification). The specification does not describe or disclose (1) what other individual materials could or should be used for each of the aforementioned layers in order to produce a superlattice having charge and/or energy transfer in a controlled direction, (2) what other combination(s) of materials is/are compatible to produce a superlattice having charge and/or energy transfer in a controlled direction, and (3) what deposition method(s) / conditions could or should be used to deposit hypothetical donor layers, acceptor layers, NLO material layers, and TSLs other than the specific materials disclosed by the applicant in order to produce the claimed superlattice. As such, one skilled in the art would not have been able to practice the full scope of the applicant's claimed invention without resorting to undue experimentation. The examiner's position is supported by the article "Supramolecular photoinduced charge transfer materials for nonlinear optics" (1998) by Duncan McBranch (the inventor in the instant application), which states that the self-assembly of charge transfer materials is a "more ambitious route" for constructing solid state materials (page 206, col.1), designing the materials which incorporate charge transfer effects is a "daunting synthetic challenge" (page 206, col.2), and "it remains as one of the principal challenges of materials chemistry to demonstrate molecular control over such macroscopic ordered supramolecular solids" (page 207, col.1). The aforementioned article clearly indicates that the synthesis of charge transfer materials by self-assembling various materials into a superlattice (i.e., a process analogous to the claimed method) is synthetically difficult and will not work unless the proper materials are utilized. Please note that Claims 27

– 29 have not been rejected on this basis because the aforementioned claims recite materials for the donor layer, acceptor layer, TSL, and NLO layer that one skilled in the art would have been able to self-assemble into a charge/energy transfer superlattice having a controlled charge/energy transfer direction without undue experimentation.

Claim Observations

12. The 35 U.S.C. 102 and 103 rejections based, at least in part, on Toshiba (EP 0 482 920 A2) are withdrawn in light of the applicant's amendment to independent Claims 1 and 14, which now require that the donor layer be deposited directly onto a substrate consisting of non-conductive glass, the NLO material layer (Claim 1) or the TSL (Claim 14) be deposited directly onto the donor layer, and the acceptor layer be deposited (directly) onto the NLO layer or the TSL. Such a process is not taught or reasonably suggested by Toshiba, alone or in combination, which requires that the substrate have a number of underlayers, including a conductive electrode layer, and does not teach the claimed layers in the claimed order.

Claim Rejections - 35 USC § 102

13. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

14. Claims 14 and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by Schrepp et al. (USPN 5,294,402).

15. Regarding amended independent **Claim 14**, Schrepp et al. teaches a method for generating materials which exhibit energy transfer having a controlled direction (Col.3, lines 10 – 39), which comprises the steps of depositing a donor layer "D" directly onto a substrate "S" (see Figure 5 and Col.1, lines 60 – 64), the substrate consisting of non-conductive glass (Col.2, lines 13 – 15, Col.5, lines 5 – 13), depositing an intermediate layer "Z" consisting of, for example, long-chain alcohols, carboxylic acids, esters, amines, or inert organic polymers having a total thickness of as little as 20 Angstroms (i.e., "a transparent spacer layer") directly onto the donor layer, and depositing an acceptor layer "A" onto the intermediate layer, whereby energy transfer is achieved between the donor layer and the acceptor layer (Abstract, Figure 5, Col.1, lines 60 – 68, Col.2, lines 1 – 50, Col.3, lines 3 – 39, and Cols. 5 – 8 (for the donor layer), and Cols. 8 – 10 (for the acceptor layer)). Additionally, Claim 14 requires that the donor layer, the spacer layer, and the acceptor layer be self-assembled into a superlattice. Schrepp et al. meets this limitation. Specifically, Schrepp et al. teaches that the layers are all deposited using a Langmuir-Blodgett (LB) technique (Col.2, lines 36 – 41). A LB technique is a self-assembly technique (see, for example, Cornell et al. (USPN 5,443,955) (Col.8, lines 14 – 19) and/or Wynne et al. (USPN 5,520,968) (Col.3, lines 19 – 22), which are simply cited to show that LB deposition is a self-assembly technique), and the

multilayer film built-up by the LB deposition process of Schrepp et al. is a "superlattice" (see, for example, Naito et al. (USPN 5,153,680) (Col.37, lines 5 – 9, Col.44, lines 30 – 34, Col.45, lines 58 – 68), which is simply cited to show that a multilayer LB film is reasonably considered to be a "superlattice"), as required by the claims. Regarding **Claim 15**, Schrepp et al. also teaches that the donor is a "conjugated polymer" (Col.6, lines 49 – 53, Col.8, lines 1 – 6), and the acceptor layer is a "porphyrin" (Col.10, lines 1 – 39).

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. Claims 16, 22, 23, 25, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schrepp et al. in view of in view of Roberts et al. (US H2046 H).

18. Schrepp et al. teaches all the limitations of **Claim 16** as set forth above in paragraph 15, except for a method wherein the donor layer and acceptor layer are selected from the group consisting of conjugated polymers, fullerenes, porphyrins, and phthalocyanines, and wherein the conjugated polymers include conjugated polyelectrolytes. Specifically, Schrepp et al. teaches that the layers (donor, acceptor, and spacer layers) are deposited using a Langmuir-Blodgett (LB) technique (Col.2,

lines 38 – 41). Roberts et al. teaches that, in the art of producing multilayer films, alternating polyelectrolyte deposition (APD) is preferable to a LB technique because (1) it allows many more substrates to be coated simultaneously in an automated process in comparison to an LB process, and (2) it eliminates the need for large bulky hydrophobic groups usually required by LB processing (Abstract, Col.4, lines 24 – 35 and 62 – 65, Col.5, lines 39 – 53, and Col.11, lines 5 – 19). Therefore, it would have been obvious to one of ordinary skill in the art to utilize APD (which is considered by the applicant to be a self-assembly technique – see, for example, page 9 of the applicant's specification) to deposit the multilayer films Schrepp, as opposed to LB deposition (as taught by Schrepp), with the reasonable expectation of successfully and advantageously reaping the benefits of APD taught by Roberts et al., such as allowing many more substrates to be coated simultaneously in an automated process in comparison to an LB process, and eliminating the need for large bulky hydrophobic groups usually required by LB processing. In doing so, one of ordinary skill in the art would have reasonably been expected to utilize materials known in the art to function in the manner desired by Schrepp (i.e., as donor layers, acceptor layers, and transparent spacer layers) and capable of being deposited by a solution-based technique such as APD so as to successfully and advantageously produce the multilayer films(s) desired by Schrepp. Such materials are taught by Roberts et al. (Cols. 5 – 10, which describe various polycations and polyanions (conjugated polyelectrolytes)). As the multilayer film produced by the deposition method taught by the aforementioned combination of references is the same as the

applicant's claimed film (i.e., a self-assembled multilayer film comprising donor, spacer, and acceptor layers), such a multilayer film is reasonably considered to be a "superlattice", as required by the claims. The aforementioned combination of references also teaches that the donor layer, acceptor layer, and transparent spacer layer are deposited by using ion-self assembly from aqueous solution (i.e., APD, as taught by Roberts et al. – see the discussion of Claim 16 above) (**Claim 25**). Regarding **Claim 22**, Roberts et al. also teaches that it is desirable to deposit various NLO-inactive polyelectrolyte buffer layers (i.e., "transparent spacer layers") throughout the thickness of the multilayer film in order to smooth the polycation or polyanion films (i.e., the NLO-active films), create a fresh surface, modify the refractive index, etc. (Col.10, lines 33 – 51). Therefore, it would have been obvious to one of ordinary skill in the art to utilize such a polyelectrolyte material as the transparent spacer layer of Schrepp with the reasonable expectation of reaping the benefits of depositing such buffer layers, such as smoothing the films, creating a fresh surface for deposition, modifying the refractive index, etc. Regarding **Claim 23**, Roberts et al. also teaches that the polyelectrolyte buffer layer (i.e., transparent spacer layer) is, for example, PSS (Col.7, lines 64 – 67). Regarding **Claim 26**, the combination of references does not explicitly teach that the conformation of the donor layer is controlled by varying the pH of the aqueous deposition solution. However, Roberts et al. teaches that, in the art of depositing a film by APD, the polycation and polyanion solutions are preferably water based and are controlled to have a pH within a specific range (Col.9, lines 48 – 60). Therefore, it would have

been obvious to one of ordinary skill in the art to control the pH in the APD process of the aforementioned combination of references (i.e., during the deposition of the donor layer, acceptor layer, NLO material layer, and transparent spacer layer) in order to insure that the APD is successfully carried out. By controlling the solution pH during deposition, the conformation of the donor layer would have inherently been "controlled by varying the pH", as claimed by the applicant.

Response to Arguments

19. Applicant's arguments filed on 9/6/2005 have been fully considered but they are not persuasive.

20. Regarding the rejections based, in part, on Schrepp et al., the applicant argues that Schrepp does not teach or suggest depositing the donor layer directly onto a non-conductive glass substrate. In response, this argument is not convincing because Schrepp does teach the aforementioned limitation (See Figure 5; Col.2, lines 13 – 15, Col.5, lines 5 – 13).

Allowable Subject Matter

21. Claims 27 and 29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 28 has been rejected under 35 U.S.C. 112, second paragraph, but no art has been applied against the claim.

22. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record, alone or in combination, does not teach or reasonably suggest depositing the claimed sequence of layers by self-assembly directly onto a non-conductive glass substrate to produce a superlattice having photoinduced charge transfer / energy transfer in a controlled direction, wherein the donor layer, acceptor layer, NLO material layer, and TSL are made of the materials claimed by the applicant in Claims 27 – 29.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D. Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tim Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Wesley D Markham
Examiner
Art Unit 1762

WDM

TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER